COMPUTATIONAL ACOUSTICS
N00014-88-K-0264
February 1, 1988 – January 31, 1990
Final Technical Report

February 8, 1992

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General Goal: To develop accurate and efficient numerical models of the acoustic propagation problem. The main considerations were: long range propagation, short range propagation, one-way outgoing or incoming (no backscatter – PE's), two-way (backscatter – Elliptics), and liquid/solid interface.

General Approach: To model physical phenonmena using partial differential equations and to apply modern numerical methods of scientific computing to their solution. The main considerations were: stability, convergence, accuracy, efficiency, error estimates, well-posedness, and applicability.

Results Were Obtained on the Following Topics:
1.) Higher Order Parabolic Methods,
2.) Error Estimates in PE's,
3.) Higher Order PE Equations with Density – Interface considerations,
4.) Elliptic Models, Backscatter, Marching,
5.) Elliptic Marching, $L1 \circ L2(u) = g(r, u)$,
6.) IFD–Shear, Liquid/Solid Interface.

Results: Seven scientific papers were written and eleven (St. Mary associated) scientific presentations were made.

Scientific Papers:

1. Accurate computation of the wide angle wave equation, *Computation Acoustics: Wave Propagation, Proceedings of the 1ˢᵗ IMACS Symposium on Computational Acoustics*, D. Lee, R.L. Sternberg, M.H. Schultz editors, 1, Elsevier Science Publishing Co., INC., North Holland, New York, 409-422 (1988) (with D. Lee).

2. Marching methods for elliptic models of underwater sound propagation. *Computation Acoustics: Wave Propagation, Proceedings of the 1ˢᵗ IMACS Symposium on Computational Acoustics*, D. Lee, R.L. Sternberg, M.H. Schultz editors, 1, Elsevier Science Publishing Co., INC., North Holland, New York, 397-407 (1988) (with G.H. Knightly).

3. Accuracy of computational methods of underwater sound propagation, *Proceedings 12ᵗʰ IMACS World Congress, July 18-22, 1988, Paris*, R. Vichnevetsky, P. Borne, J. Vignes, editors, IMACS, Paris, 2, 234-236 (1988) (with G.H. Knightly, D. Lee).

4. Analysis and computation using higher order parabolic equations that include density variations, *Proceedings 12ᵗʰ IMACS World Congress, July 18-22, 1988, Paris*, R. Vichnevetsky, P. Borne, J. Vignes, editors, IMACS, Paris, 2, 237-240 (1988) (with G.H. Knightly, D. Lee).

5. Analysis of the accuracy of a computational method for the parabolic wave equation, *Numerical and Applied Mathematics*. W. F. Ames (ed.), J.C. Baltzer AG, Scientific Publishing Co., IMACS, 329-334 (1989) (with G.H. Knightly, D. Lee).

6. Derivation and discretization of parabolic equations containing arbitrary density functions, *Numerical and Applied Mathematics*. W. F. Ames (ed.), J.C. Baltzer AG, IMACS, Scientific Publishing Co., IMACS, 323-328 (1989) (with G.H. Knightly, D. Lee).

7. Computational ocean acoustics, to appear *Proceedings of the Second Edward Bouchet Conference on Physics and Technology*, Accra, Ghana, 99-108, 1990 (with G. H. Knightly).

REPORT OF INVENTIONS AND SUBCONTRACTS

(Pursuant to "Patent Rights" Contract Clause) (See Instructions on Reverse Side)

1a. NAME OF CONTRACTOR / SUBCONTRACTOR
University of Massachusetts

b. ADDRESS (Include ZIP Code)
Grant & Contract Admin.
Amherst, MA 01003

c. CONTRACT NUMBER
N00014-88-K-0264

d. AWARD DATE (YYMMDD)
02/01/88 - 01/31/91

2a. NAME OF GOVERNMENT PRIME CONTRACTOR
SAME as 1a.

b. ADDRESS (Include ZIP Code)
SAME as 1b.

c. CONTRACT NUMBER
SAME as 1c.

d. AWARD DATE (YYMMDD)
SAME as 1d.

3. TYPE OF REPORT (X one)
a. INTERIM   b. FINAL

4. REPORTING PERIOD (YYMMDD)
a. FROM
b. TO

SECTION I – SUBJECT INVENTIONS

5. "SUBJECT INVENTIONS" REQUIRED TO BE REPORTED BY CONTRACTOR / SUBCONTRACTOR (If "None," so state)

a. NAME(S) OF INVENTOR(S) (Last, First, MI)
NONE

b. TITLE OF INVENTION(S)
NONE

c. DISCLOSURE NO. PATENT APPLICATION SERIAL NO OR PATENT NO

d. ELECTION TO FILE PATENT APPLICATIONS
(1) United States — (a) Yes / (b) No
(2) Foreign — (a) Yes / (b) No

e. CONFIRMATORY INSTRUMENT OR ASSIGNMENT FORWARDED TO CONTRACTING OFFICER
(1) Yes / (2) No

6. EMPLOYER OF INVENTOR(S) NOT EMPLOYED BY CONTRACTOR / SUBCONTRACTOR

(1)(a) Name of Inventor (Last, First, MI)
NONE

(2)(a) Name of Inventor (Last, First, MI)

(b) Name of Employer

(c) Address of Employer (Include ZIP Code)

g. ELECTED FOREIGN COUNTRIES IN WHICH A PATENT APPLICATION WILL BE FILED
(1) Title of Invention — NONE
(2) Foreign Countries of Patent Application

SECTION II – SUBCONTRACTS (Containing a "Patent Rights" clause)

6. SUBCONTRACTS AWARDED BY CONTRACTOR / SUBCONTRACTOR (If "None," so state)

a. NAME OF SUBCONTRACTOR(S)
NONE

b. ADDRESS (Include ZIP Code)

c. SUBCONTRACT NO (S)

d. DFAR "PATENT RIGHTS"
(1) Clause Number
(2) Date (YYMM)

e. DESCRIPTION OF WORK TO BE PERFORMED UNDER SUBCONTRACT(S)

f. SUBCONTRACT DATES (YYMMDD)
(1) Award
(2) Estimated Completion

SECTION III – CERTIFICATION

Signatures

7. CERTIFICATION OF REPORT BY CONTRACTOR / SUBCONTRACTOR (XXXXX)

a. NAME OF AUTHORIZED CONTRACTOR / SUBCONTRACTOR OFFICIAL (Last, First, MI)
Lee D. Beatty

b. TITLE
Principal Investigator
Director
Grant & Contract Admin.

c. XXXXXX

d. SIGNATURE
B. B. Mary

Contracting Official

DD Form 882, OCT 89